TEMPCO®

USER MANUAL

# PCT-3000 Series

## Temperature Control Console with TEC-2400 with Relay Output for Heating or Cooling Applications


CERTIFIED QUALITY COMPANY TEMPCO ISO 9001:2015

Manual PCT-3000 • Revision 9/19
D1342

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The PCT-3000 series control console incorporates a TEC-2400 model PID temperature controller in a polycarbonate housing offering plug and play operation for the purpose of controlling temperature.

A 5 foot cord, 15A straight blade heater receptacle, audible alarm, load fusing, and outdoor wall mounting kit are provided.

## All models have the following specifications in common:

**Input**

| | |
|---|---|
| Thermocouple (T/C) | Type K, J. See Product label. Uses mini-type connectors. |
| Cold junction compensation | Automatic |
| Input break protection | Built-in, upscale on open sensor and output off. |

**Control Modes**

| | |
|---|---|
| On-Off | Hysteresis: Adjustable .1°F - 100.0°F hysteresis control (PB=0) |
| P or PD | 0.1 - 100.0% offset adjustment |
| PID | Fuzzy Logic Modified<br>Proportional Band: 0.1 - 900° F<br>Integral Time: 0-1000 seconds<br>Derivative time: 0 - 360 seconds |
| Cycle Time | 0.1 - 100 seconds<br>***Caution: Settings less than 6 sec. will shorten relay life*** |
| Manual Control | Heat or Cooling |
| Auto Tuning | Cold start or warm start |
| Failure Mode | Auto-transfer to manual mode with sensor break or A-D converter failure |
| Ramping Control | 0° - 900°F/min or 0° - 900°F/hour ramp rate |

**Indication/Interface** Single 4 digit LED display: 0.4”/10mm Keypad: 3 keys

**Set Point**

| | |
|---|---|
| Resolution | 18 bits |
| Accuracy | ± 0.10% of full scale ±1 LSD at 77°F/25°C |
| Range | 0-1200°F (J t/c) or 0-2400°F (K t/c) See product label |

**Power**

| | |
|---|---|
| Rating | 120VAC (1440W) or 240VAC(2880W) See product label |
| Consumption | Less than 3VA. |

**Environmental and Physical**

| | |
|---|---|
| Operating Temperature | 14 to 122°F (-10 to 50°C) |
| Humidity | 0–90% RH (non-condensing) |
| Insulation | 20M ohm min. (5000VDC) |
| Breakdown | 2000VAC, 50/60Hz, 1 minute |
| Weight | 5lbs (80oz) |

**Dimensions**: 5” square

| Tempco Part Number | Maximum Heater Amps | Volts AC | Amps (fused) | Maximum Wattage | Temperature Range | Sensor Type & Color Code |
|---|---|---|---|---|---|---|
| PCT30017 | 12 | 120 | 15 | 1440 | 0-1200°F | J T/C black |
| PCT30018 | 12 | 240 | 15 | 2880 | 0-1200°F | J T/C black |
| PCT30019 | 12 | 120 | 15 | 1440 | 0-2400°F | K T/C yellow |
| PCT30020 | 12 | 240 | 15 | 2880 | 0-2400°F | K T/C yellow |

## WIRING (for safety, unplug unit prior to making any heater or sensor connections)

1. Attach the leads from your thermocouple to the provided thermocouple plug.

2. The heater output current is sourced directly thru the line cord. The bottom console output receptacle provides live controlled power for direct connection to your heater(s).

## OPERATION

1. Verify the power switch is in the off position. Plug your heater into the straight-blade enclosure connector. Plug the provided line cord from the console into a standard outlet. Switch on the enclosure.

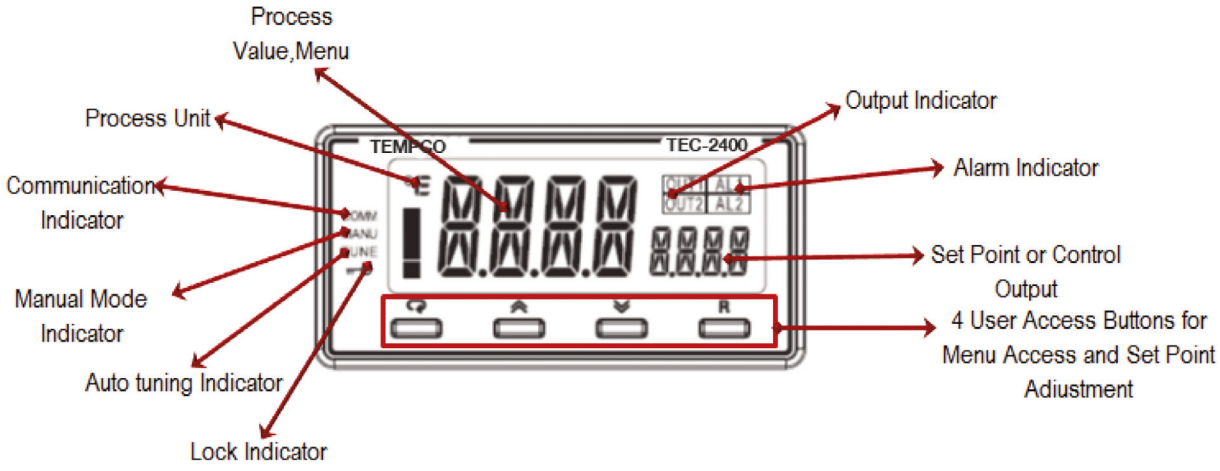
2. Using the up & down pushbuttons on the TEC-2400 controller, start out with the temperature set low to test your system. If the setpoint temperature is being maintained, set your desired temperature setpoint.

   **Note: The signal for the audible alarm circuit is wired through output 2 of the TEC-2400 which be used as a cut-out in the event of an over-setpoint temperature condition. This is a deviation contact set to 30º F above the setpoint.**
   **This audible alarm can be changed by accessing "A1.DV" in the TEC-2400 (note that this setting is located in the** "Alarm" menu**).**

3. Auto-tuning is recommended for initial set-up. Refer to page 8 of the attached manual for auto-tuning procedures.

## SPARE/REPLACEMENT PARTS

| Part Number | Description |
|---|---|
| EHD-124-148 | (1) or (2) Main fuse(s) rated 15 amps, 250V, 1/4 x 1¼", fast acting, Bussmann ABC-15-R or equivalent. |
| EHD-124-276 | Control fuse (1) rated 1 amp, 250V, 1/4 x 1¼", fast acting, Bussmann ABC-1-R or equivalent. (not present on 120V Models) |

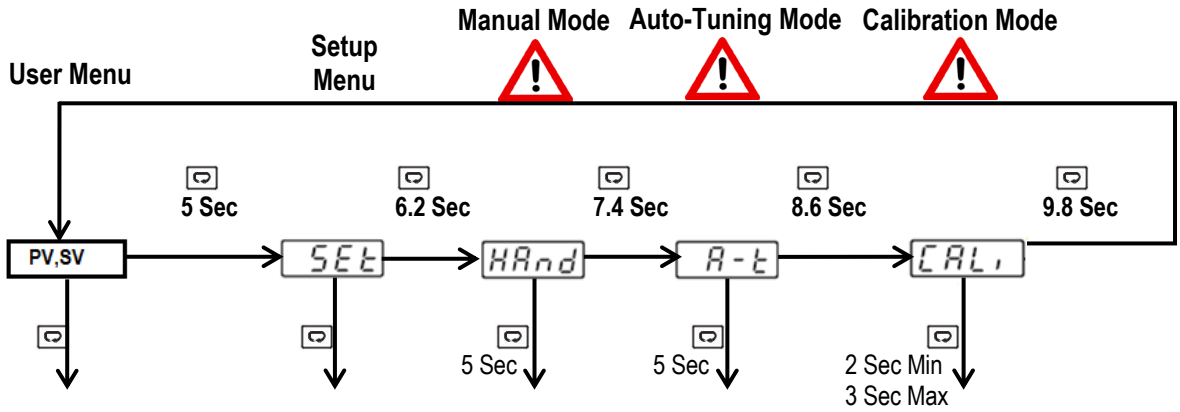



**1-4. TEC-2400 Front Panel Keys and Display**

## 1.1 Menu Flowchart

The Menu has been divided in to 5 groups. They are as follows:

1. User Menu
2. Setup Menu
3. Manual Mode Menu
4. Auto-Tuning Mode Menu
5. Calibration Mode Menu




To access a parameter In the User Menu, Refer to Section 1.1.1.1, page 5

To access a parameter in the Setup Menu, Refer to Section 1.1.1, Starting on Page 5. 8 Sub-menu options are available for the setup menu.
- Basic Menu
- Output Menu
- Alarm Menu
- Event Input Menu
- User Select Menu

To start Manual Control Mode, Refer to Section 1.1.2 Page 7 & 18

To start Auto-Tuning Mode, Refer to Section 1.1.3 Page 7, 15 & 16

To access Calibration Mode, Refer to Section 2.5 Page 14

Press ⊡ for the next parameter
Press ⊡ and ▲ key to return to the previous parameter.

**Not Applicable*

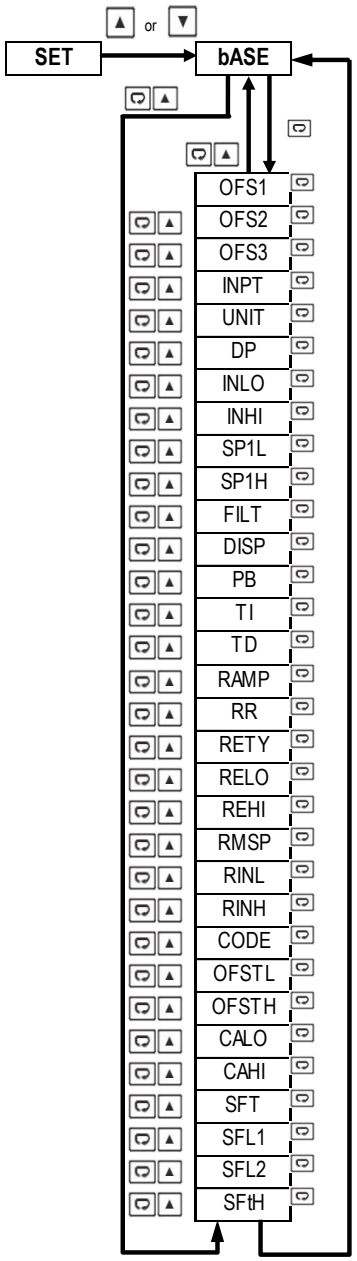
### *1.1.1 Setup Menu*

The setup menu has been categorized in to eight categories. They are listed below.

1. Basic Menu (pg 5)
2. Output Menu (pg. 6)
3. Alarm Menu
*4. Event Input Menu
*5. User Select Menu
*6. Communication Menu
*7. Current Transformer Menu
*8. Profile Menu (Ramp and Soak)

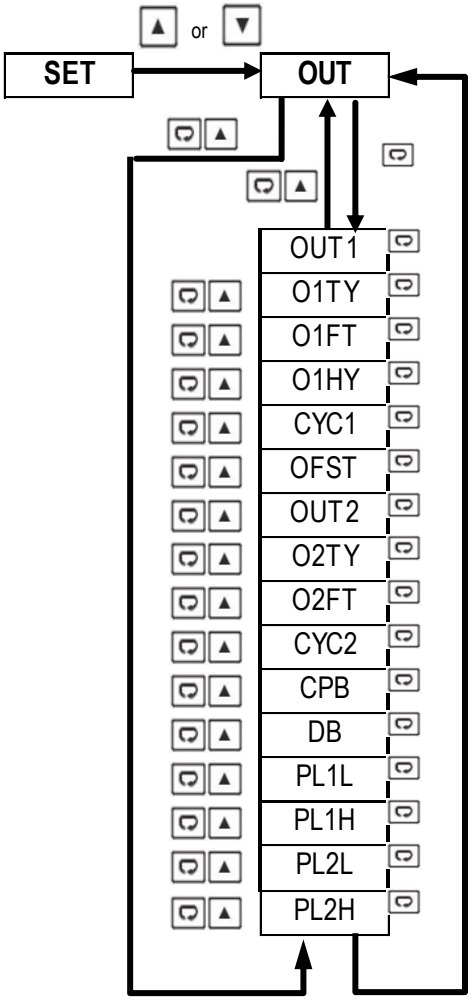
#### *1.1.1.1 Basic Menu (bASE)*

In the setup menu, when the upper display says “SET”, Use the ▲ or ▼ keys to get “bASE” in the lower display. Then, use the ⟲ key to cycle through the “bASE” menu parameters (Note Chart on pg. 8).



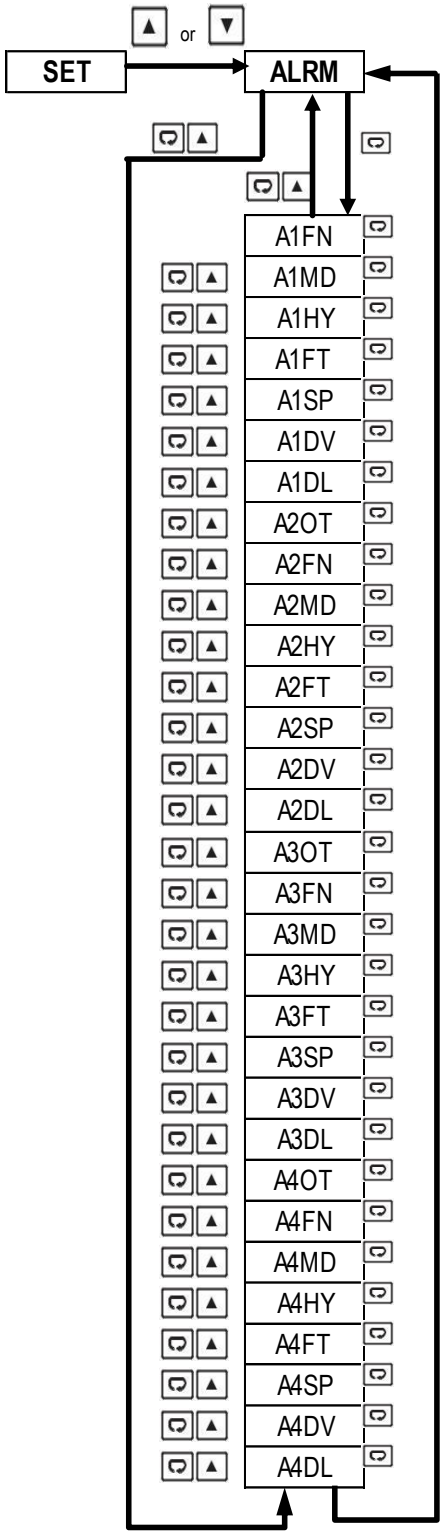
### *1.1.1.2 Output Menu (oUT)*

In the setup menu, when the upper display says “SET”, use the ▲ or ▼ key to get “oUT” in the lower display. Then, use the ⟲ key to cycle through the “oUT” menu parameters (Note Chart on pg. 9).



### *1.7.2.3 Alarm Menu (ALRM)*

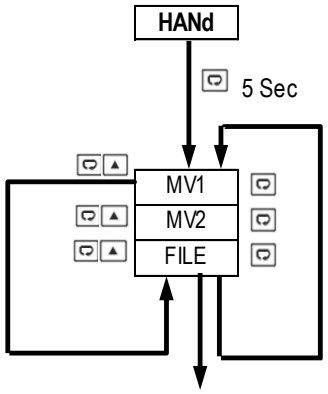
In the setup menu, when the upper display says “SET”, use the ▲ or ▼ key to get “ALRM” in the lower display. Then use the “ ” key to cycle through the “ALRM” menu parameters.



### *1.1.2 Manual Mode Menu – (Use for Temporary Operation if Sensor Fails)*

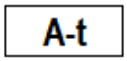
Press and hold the "⊡" key for approx. 6sec until the "HAND" parameter is shown in the upper display. Then, press and hold the "⊡" key for an additional 5 sec. until an "MANU" led starts to flash in the lower left of the display. Then, use the "⊡" key to cycle through the available options.
User is able to manually set the out output to be energized from 0-100% of the cycle time.
"Hx.xx" is used to adjust output 1.
"Cx.xx" is used to adjust output 2.

You are able to exit manual mode by pressing and holding the R key.




Press ⊡ key 5 Sec To execute the selected default program

### *1.1.3 Auto-Tuning Mode – (Tunes PID Parameters to Your Application)*




Press and hold the "⊡" key for approx. 7sec until the "A-T" parameter is shown in the upper display. Press and hold the "⊡" key for 5 seconds to activate Auto-Tuning Mode. Continue to hold the "⊡" key for an additional 3 seconds, else the display will revert to a "User Menu" parameter.

Auto-tuning allows the controller to find its own optimal control parameters (PID) by measuring the speed of your thermal process.

## 1.2 Parameter Description

*(*Parameters that are not applicable are not shown)*

| Register Address | Parameter Notation | Parameter Description | Range | Default Value |
|---|---|---|---|---|
| 0 | SP1 | Set Point 1<br>(Used for Output 1) | Low: SP1L<br>High: SP1H | 77.0°F |
| 1 | A1.DV | Set Point 2<br>(Used for Output 2/Alarm 1) | Low: SP1L<br>High: SP1H | 30.0°F |
| 8 | INPT | Input sensor selection | **0** ***J_tC***: J type Thermocouple<br>**1** ***K_tC***: K type Thermocouple<br>**2** ***T_tC***: T type Thermocouple<br>**3** ***E_tC***: E type Thermocouple<br>**4** ***B_tC***: B type Thermocouple<br>**5** ***R_tC***: R type Thermocouple<br>**6** ***S_tC***: S type Thermocouple<br>**7** ***N_tC***: N type Thermocouple<br>**8** ***L_tC***: L type Thermocouple<br>**9** ***U_tC***: U type Thermocouple<br>**10** ***P_tC***: P type Thermocouple<br>**11** ***C_tC***: C type Thermocouple<br>**12** ***D_tC***: D type Thermocouple<br>**13** ***Pt.dN***: PT100 Ω DIN curve<br>**14** ***Pt.JS***: PT100 Ω JIS curve<br>**15** ***4-20***: 4-20mA linear current input<br>**16** ***0-20***: 0-20mA linear current input<br>**17** ***0-5V***: 0-5VDC linear voltage input<br>**18** ***1-5V***: 1-5VDC linear voltage input<br>**19** ***0-10***: 0-10VDC linear voltage input | 0, 1 or 13<br>(Depends on Model Ordered) |
| 9 | UNIT | Input unit selection | **0** ***oC***:°C unit<br>**1** ***oF***:°F unit<br>**2** ***Pu***:Process unit | 1 |
| 10 | DP | Decimal point selection | **0** ***No.dP***: No decimal point<br>**1** ***1-dP***: 1 decimal digit<br>**2** ***2-dP***: 2 decimal digit<br>**3** ***3-dP***: 3 decimal digit | 0 |
| 13 | SP1L | Low limit of set point 1<br>(Span Value) | Low: -19999<br>High :SP1H | 0.0° F |
| 14 | SP1H | High limit of set point 1<br>(Span Value) | Low: SP1L<br>High: 45536 | 1000.0°F |
| 15 | FILT | Filter damping time constant of PV Sensor | **0** ***0***: 0 second time constant<br>**1** ***0.2***: 0.2 second time constant<br>**2** ***0.5***: 0.5 second time constant<br>**3** ***1***: 1 second time constant<br>**4** ***2***: 2 second time constant<br>**5** ***5***: 5 second time constant<br>**6** ***10***: 10 second time constant<br>**7** ***20***: 20 second time constant<br>**8** ***30***: 30 second time constant<br>**9** ***60***: 60 second time constant | 2 |

*(*Parameters that are not applicable are not shown)*

| Register Address | Parameter Notation | Parameter Description | Range | Default Value |
|---|---|---|---|---|
| 16 | DISP | Secondary display selection | **0** ***None***: No Display<br>**1** ***MV1***: Display MV1<br>**2** ***MV2***: Display MV2<br>**3** ***tIMR***: Display Dwell Time<br>**4** ***PRoF:*** display Profile Status | 0 |
| 17 | PB | Proportional band value | Low: 0.0<br>High: 500.0°C (900.0°F) | 10.0° C<br>(18.0° F) |
| 18 | TI | Integral time value | Low: 0<br>High: 3600 sec | 100 |
| 19 | TD | Derivative time value | Low: 0.0<br>High: 360.0 sec | 25 |
| 20 | OUT1 | Output 1 function | **0** ***REVR***: Reverse (heating) control action<br>**1** ***dIRt*** : Direct (cooling) control action | 0 |
| 21 | O1TY<br><br>FACTORY SET, DO NOT CHANGE | Output 1 signal type | **0** ***RELY***: Relay output<br>**1** ***SSrd***: Solid state relay drive output<br>**2** ***4-20***: 4-20mA linear current<br>**3** ***0-20***: 0-20mA linear current<br>**4** ***0-5V***: 0-5VDC linear voltage<br>**5** ***1-5V***: 1-5VDC linear voltage<br>**6** ***0-10***: 0-10VDC linear voltage | 1 |
| 22 | O1FT | Output 1 failure transfer mode<br>(See Pg. 15) | Select BPLS (Bumpless transfer), or 0.0 ~ 100.0 % to continue output 1 control function if the sensor fails, or select OFF (0) or ON (1) for ON-OFF control | 0 |
| 23 | O1HY | Output 1 ON-OFF control hysteresis. PB=0 | Low: 0.1°C (0.2°F)<br>High: 50.0°C (90.0°F) | 0.1° C<br>(0.2 °F) |
| 24 | CYC1 | Output 1 cycle time | Low: 0.1<br>High: 90.0 sec. | 1.0 |
| 26 | RAMP | Ramp function selection | **0** ***NoNE***: No Ramp Function<br>**1** ***MINR***: Use º/minute as Ramp Rate<br>**2** ***HRR***: Use º/hour as Ramp Rate | 0 |

*(*Parameters that are not applicable are not shown)*

| Register Address | Parameter Notation | Parameter Description | Range | Default Value |
|---|---|---|---|---|
| 27 | RR | Ramp rate | Low: 0.0<br>High: 900.0°F | 0 |
| 28 | OUT2 | Output 2 function | **0** ***NoNE***: Output2 turned off<br>**1** ***COOL***: Cooling PID Function<br>**2** ***AL1***: Alarm 1 Function<br>**3** ***rAL1***: Reverse Alarm 1 Function | 2 |
| 34 | A1FN | Alarm 1 function for alarm 1 output | **0** ***NoNE***: No alarm function<br>**1** ***dtMR***: Dwell timer action<br>**2** ***dE.HI***: Deviation high alarm<br>**3** ***dE.Lo:*** Deviation low alarm<br>**4** ***db.HI***: Deviation band out of band alarm<br>**5** ***db.Lo***: Deviation band in band alarm<br>**6** ***PV.HI***: Process value high alarm<br>**7** ***PV.Lo***: Process value low alarm<br>**8** ***H.bK***: Heater break alarm<br>**9** ***H.St***: Heater short alarm | 3 |
| 61 | PL1L | Output 1 Low Power limit | Low: 0<br>High:PL1H or 50% | 0 |
| 62 | PL1H | Output 1 High Power limit | Low: PL1L<br>High: 100 % | 100 |
| 94 | PASS | Password entry<br>(See Next Page) | Low: 0<br>High: 9999 | 0 |

# 2 Programming

Press and hold ⊡ for 5 seconds, then release to enter the setup menu. Press and release ⊡ to cycle through the list of parameters. The upper display indicates the parameter symbol, and the lower display indicates the value of the selected parameter.

## 2.1 User Security

There are two parameters, PASS (password) and CODE (security code), which will control the lockout program.

| CODE Value | PASS Value | Access Rights |
|---|---|---|
| 0 | Any Value | All parameters are changeable |
| 1000 | =1000 | All parameters are changeable |
| | ≠1000 | Only user menu parameters changeable |
| 9999 | =9999 | All parameters are changeable |
| | ≠9999 | Only SP1 to SP7 are changeable |
| Others | =CODE | All parameters are changeable |
| | ≠CODE | No parameters can be changed |

***2-1.User Access Rights***

## 2.2 Signal Input

**INPT:** Select the desired sensor type or signal type for the signal input. Factory set.
**DO NOT CHANGE**

**UNIT:** Select the desired process unit
**Options: °**C, °F, PU (Process unit). If the unit is neither °C nor °F, then is set to PU.

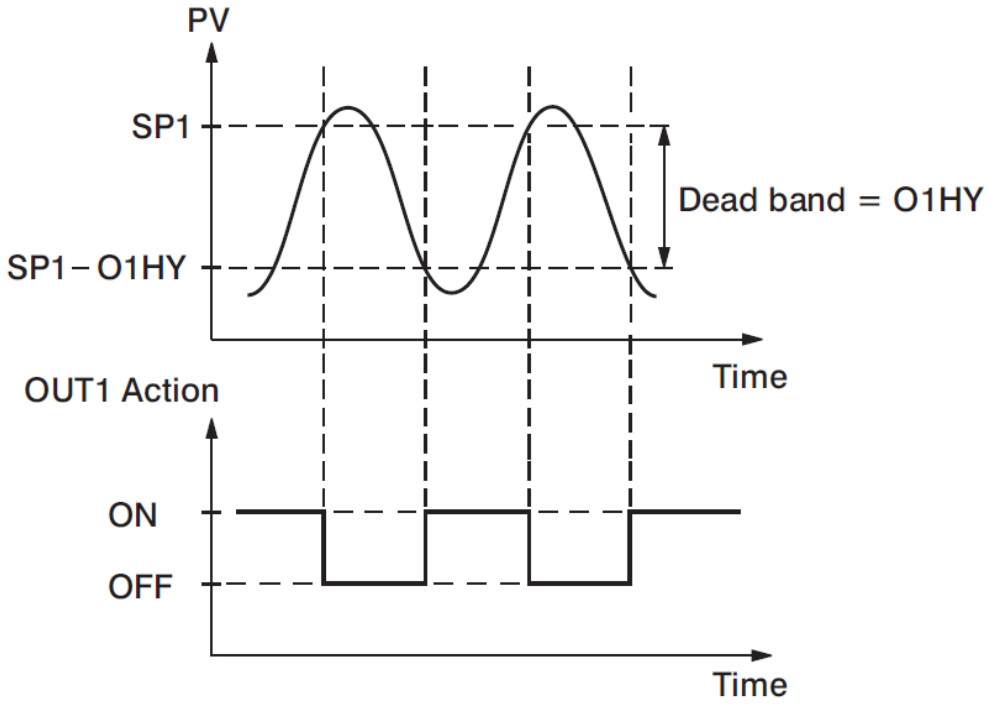
**DP:** Select the desired resolution (decimal points) for the process value.

## 2.3 Control Output

There are 4 kinds of control modes can be configured as shown below.

### *2.3.1 Heat Only ON-OFF Control – (Used for Solonoids and Valves)*

Select REVR for OUT1, Set PB to 0. O1HY is used to adjust the hysteresis for ON-OFF control. The output 1 hysteresis (O1HY) setting is only available when PB = 0. The heat only ON-OFF control function is shown below.




***2-1.Heat Only ON-OFF Control***

ON-OFF control may cause excessive process oscillations even if the hysteresis is set to the smallest value. If ON-OFF control is used (i.e. PB = 0), TI, TD, CYC1, OFST, CYC2, CPB, DB will no longer be applicable and will be hidden. Auto-Tuning mode and Bumpless transfer are not possible in on/off mode.

### *2.3.2 Heat only P or PD Control – (Used for Electric Heaters)*

Select REVR for OUT1, set TI = 0, OFST is used to adjust the control offset (manual reset). If PB ≠0 then O1HY will be hidden.

**OFST Function:** OFST is measured in % with a range of 0 - 100.0 %. When the process is stable, let's say the process value is lower than the set point by 5°F. Let's also say that 20.0 is used for the PB setting. In this example, 5°F is 25% of the proportional band (PB).

By increasing the OFST value by 25%, the control output will adjust itself, and the process value will eventually coincide with the set point.

When using Proportional (P) control (TI = 0), Auto-Tuning will be unavailable. Refer to the "manual tuning" section for the adjustment of PB and TD. Manual reset (OFST) is usually not practical because the load may change from time to time; meaning the OFST setting would need to be constantly adjusted. PID control can avoid this problem

### *2.3.3 Heat only PID Control – (Default for Electric Heaters)*

Select REVR for OUT1. PB and TI should not be zero. Perform Auto-Tuning for initial startup. If the control result is not satisfactory, use manual tuning or try Auto-Tuning a second time to improve the control performance.

### *2.3.4 Cool only Control*

ON-OFF control, Proportional control, and PID control can be used for cooling control. Set “OUT1” to DIRT (direct action).

**NOTE:** ON-OFF control may result in excessive overshoot and undershoot in the process. Proportional control could result in a deviation of the process value from the set point. It is recommended to use PID control for Heating or Cooling control to produce a stable process value.

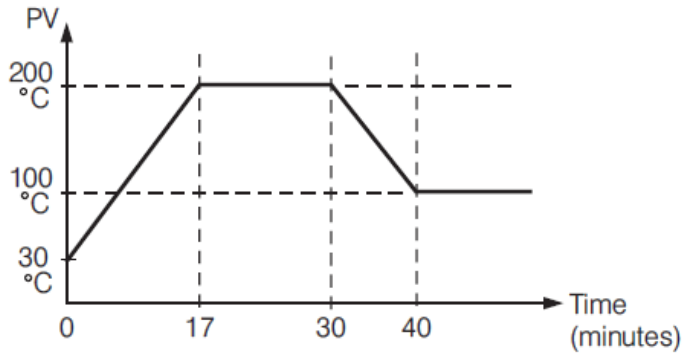
When selecting parameters, all of the above parameters may not be available. The number of visible parameters depends on the configuration of the controller.

## 2.4 Ramp

The ramping function is performed during power up or any time the set point is changed. Choose “MINR” (ramp in minutes) or “HRR” (ramp in hours) for the “RAMP” setting, and the controller will perform the ramping function. The ramp rate is programmed by adjusting the “RR” setting. The ramping function is disabled whenever the controller enters Failure mode, Manual control mode, Auto-Tuning mode or Calibration mode.

### *2.4.1 Ramping Example without Dwell Timer*

Set the “RAMP” setting to “MINR” to ramp in minutes.
Set the ramp rate (RR) to 10.
The starting temperature is 30°C.
The setpoint is initially set to 200°C.
After the process warms up, the user changed the setpoint to 100°C after 30 minutes.
After power up, the process will behave as shown below.




***2-2.Ramp Function***

**Note:** When the ramp function is used, the lower display will show the current ramping value. However, it will revert to show the set point value as soon as the up or down key is touched for adjustment. The ramp rate is initiated at power on and/or whenever the Set point is changed. Setting the “RR” setting to zero means no ramping function is used.

## 2.5 User Calibration

Each unit is calibrated in the factory before shipment. The user can still modify the calibration in the field. The basic calibration of the controller is highly stable and set for life. User calibration allows the user to offset the permanent factory calibration in order to:

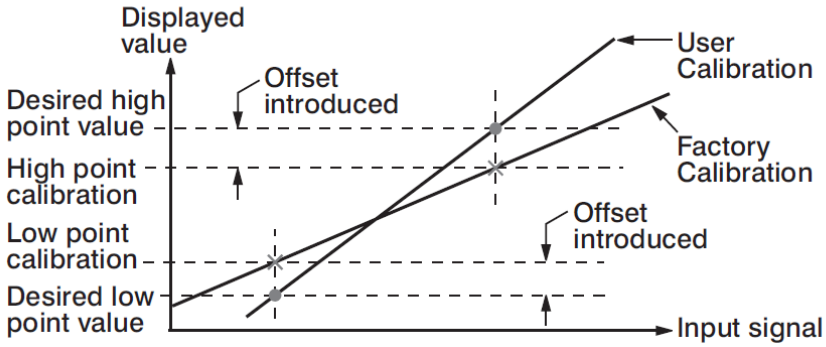
- ❖ Calibrate the controller to meet a user reference standard.
- ❖ Match the calibration of the controller to that of a particular transducer or sensor input.
- ❖ Calibrate the controller to suit the characteristics of a particular installation.
- ❖ Remove long term drift in the factory set calibration.

There are two parameters: Offset Low (OFTL) and Offset High (OFTH) for adjustment to correct an error in the process value.

There are two parameters for the sensor input. These two signal values are CALO and CAHI. The input signal low and high values are to be entered in the CALO and CAHI parameters respectively.

Refer to section 1.6 for key operation and section 1.7 for the operation flowchart. Press and hold the ⊙ key until the setup Menu page is obtained. Then, press and release the ⊙ key to navigate to the calibration low parameter OFTL. Send your low signal to the sensor input of the controller, then press and release the ⊙ key. If the process value (the upper display) is different from the input signal, the user can use ▲ and ▼ keys to change the OFTL value (the lower display) until the process value is equal to the value the user needs. Press and hold the ⊙ key for 5 seconds to complete the low point calibration (the display should blink once). The same procedure is applied for high scale calibration.

As shown below, the two points OFTL and OFTH construct a straight line. For the purpose of accuracy, it is best to calibrate with the two points as far apart as possible. After the user calibration is complete, the input type will be stored in the memory. If the input type is changed, a calibration error will occur and an error code CAEr is displayed.

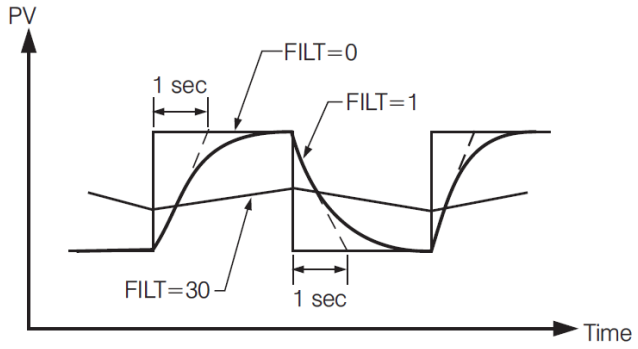



***2-3.Two Point User Calibration***

## 2.6 Digital Filter

In certain applications the process value is too unstable to be read. To improve this, a programmable low pass filter incorporated in the controller can be used. This is a first order filter with a time constant specified by the FILT parameter. A value of 0.5 seconds is used as a factory default. Adjust FILT to change the time constant from 0 to 60 seconds. 0 seconds represents no filter applied to the input signal. The filter is characterized by the following diagram.

**Note:** The Filter is available only for the process value (PV), and is performed for the displayed value only. The controller is designed to use an unfiltered signal for control even when a filter is applied. If a lagged (filtered) signal is used for control; it may produce an unstable process.




***2-4.Filter Characteristics***

## 2.7 Failure Transfer

The controller will enter failure mode if one of the following conditions occurs:

1. An SBER error occurs due to an input sensor break, an input current below 1mA for 4-20mA, or an input voltage below 0.25V for 1-5 V.
2. An ADER error occurs due to the A-D converter failing.

*Output 1 and Output 2 will perform the failure transfer (O1.ft & O2.ft) function as the controller enters failure mode.*

### *2.7.1 Output 1 Failure Transfer*

If Output 1 Failure Transfer is activated, it will perform as follows:

1. If output 1 is configured as proportional control (PB≠0), and BPLS is selected for O1FT, then output 1 will perform a Bumpless transfer. After that, the previous average value of of the output will be used for controlling output 1.
2. If output 1 is configured as proportional control (PB≠0), and a value of 0 to 100.0 % is set for O1FT, then output 1 will perform failure transfer. After that the value of O1FT will be used for controlling output 1.
3. If output 1 is configured as ON-OFF control (PB=0), then output 1 will transfer to an off state if OFF is set for O1FT, or it will transfer to an on state if ON is set for O1FT.

## 2.8 Auto-Tuning

⚠The Auto-Tuning process will be performed at the set point (SP1). The process will oscillate around the set point during the tuning process. Set a set point to a lower value if overshooting beyond the normal process value will cause damage. It is usually best to perform Auto-Tuning at the Set point the machine is expected to be operated at, with the process running normally (i.e. material in the oven, etc.)

Auto-Tuning is generally applied in the following cases:

- ❖ Initial setup for a new process
- ❖ The set point is changed substantially from the previous Set point when Auto-Tuning was performed.
- ❖ The control result is unsatisfactory

### *2.8.1 Auto-Tuning Operation Steps*

1. The system is set up to run under real-world conditions.
2. "PB and "TI" settings should not be set to zero.
3. The LOCK parameter should be set to NONE.
4. Set the set point to a normal operating value, or a lower value if overshooting beyond the normal process value will cause damage.
5. Press and hold the ⏎ key until A-t appears on the upper display. Continue to hold the "⏎" key for an additional 3 seconds, else the display will revert to a "User Menu" parameter.
6. Press and hold the ⏎ key until the TUNE indicator begins to flash.
7. The Auto-Tuning process has begun.

**NOTE:**
During Auto-Tuning, the output will stay on until the Process Value reaches the setpoint. This is likely to cause the temperature to exceed the setpoint.
Then, the output will remain off until the process value falls below the setpoint.
This will occur at least two times while the controller "learns" how to control your process.

**Procedures:**

Auto-Tuning can be applied either as the process is warming up (Cold Start) or as the process has been in steady state (Warm Start). After the Auto-Tuning process is completed, the TUNE indicator will stop flashing and the unit will revert to PID control by using its new PID values. The PID values obtained are stored in nonvolatile memory.

### *2.8.2 Auto-Tuning Error*

If Auto-Tuning fails, an ATER AtEr message will appear on the upper display in any of the following cases.

- ❖ If PB exceeds 9000 (9000 PU, 900.0°F or 500.0°C)
- ❖ If TI exceeds 1000 seconds
- ❖ If the set point is changed during the Auto-Tuning process

### *2.8.3 Solution for an Auto-Tuning Error*

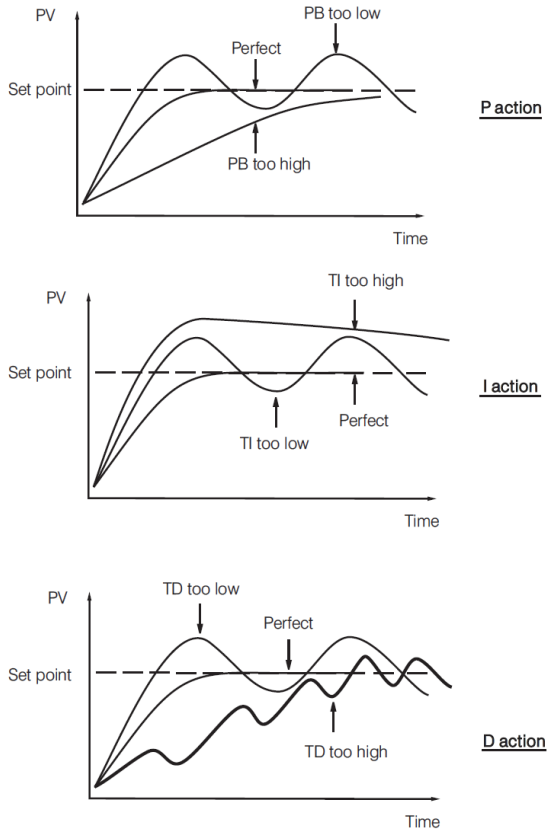
1. Try Auto-Tuning once again.
2. Avoid changing the set point value during the Auto-Tuning process.
3. Ensure PB and TI are <u>not</u> set to zero.
4. Use manual tuning.
5. Touch RESET R key to reset the AtEr message.

## 2.9 Manual Tuning

In certain applications, using Auto-Tuning may be inadequate for the control requirement, or, the process moves too slowly to Auto-tune accurately.
If this is the case, the user can try manual tuning.
If the control performance by using Auto-Tuning is still unsatisfactory, the following guidelines can be applied for further adjustment of PID values.

| ADJUSTMENT SEQUENCE | SYMPTOM | SOLUTION |
|---|---|---|
| Proportional Band ( PB ) | Slow Response | Decrease PB |
| | High overshoot or Oscillations | Increase PB |
| Integral Time ( TI ) | Slow Response | Decrease TI |
| | Instability or Oscillations | Increase TI |
| Derivative Time ( TD ) | Slow Response or Oscillations | Decrease TD |
| | High Overshoot | Increase TD |

***2-2.PID Parameter Adjustment Guide***




***2-5. Effects of PID Adjustment***

## 2.10 Manual Control

To enable manual control, ensure the LOCK parameter is set to NONE.
Press and hold ⊙ until HAnd ---- (Hand Control) appears on the display. Press and hold ⊙ until the "MANU" indicator begins to flash. The lower display will show H---.
H--- Indicates the output control variable for output 1, and C--- indicates the control variable for output 2. The user can use the up-down keys to adjust the percentage values for the heating or cooling output. This % value is based on the CYC1 and CYC2 settings, where the associated output will stay on for the % of time the CYC1 & CYC2 values are set for.

Example: If CYC1 is set to 20seconds, and the controller is set to "H50.0", the output will be on for 10seconds, then turn off for 10 seconds.

The controller performs open loop control and ignores the input sensor as long as it stays in manual control mode

### *2.10.1 Exit Manual Control*

Pressing the R key will revert the controller to its normal display mode.

## 2.11 Setting Controller to Factory Default

The controller's parameters can be loaded with default values listed in the parameter description table . In certain situation it is desirable to retain these values after the parameters values has been changed. The below procedure to be followed to reload the default values.

1. Ensure the LOCK parameter is set to NONE.
2. Press and hold ⊙ until HAnd ---- (Hand Control) appears on the display.
3. Press and release the ⊙ key to cycle through the manual mode menu to reach "FILE".
4. Press and hold ⊙ for 5 seconds or until the upper display FILE flash for a moment.

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